IEA 4E Solid-State Lighting Annex

ssl.iea-4e.org

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THE SSL ANNEX 2010-2014

- Preparatory document: France, USA, Japan
- 8 Funding countries:
  - France, Australia, The Netherlands, United Kingdom, Sweden, Denmark, Japan, USA
- Others member countries welcome

THE SSL ANNEX 2010-2014

Goal: to provide governments with the tools to assess the performance of SSL, inform energy-efficient lighting policies and harmonize test procedures and laboratory accreditation to increase confidence in Solid State Lighting.

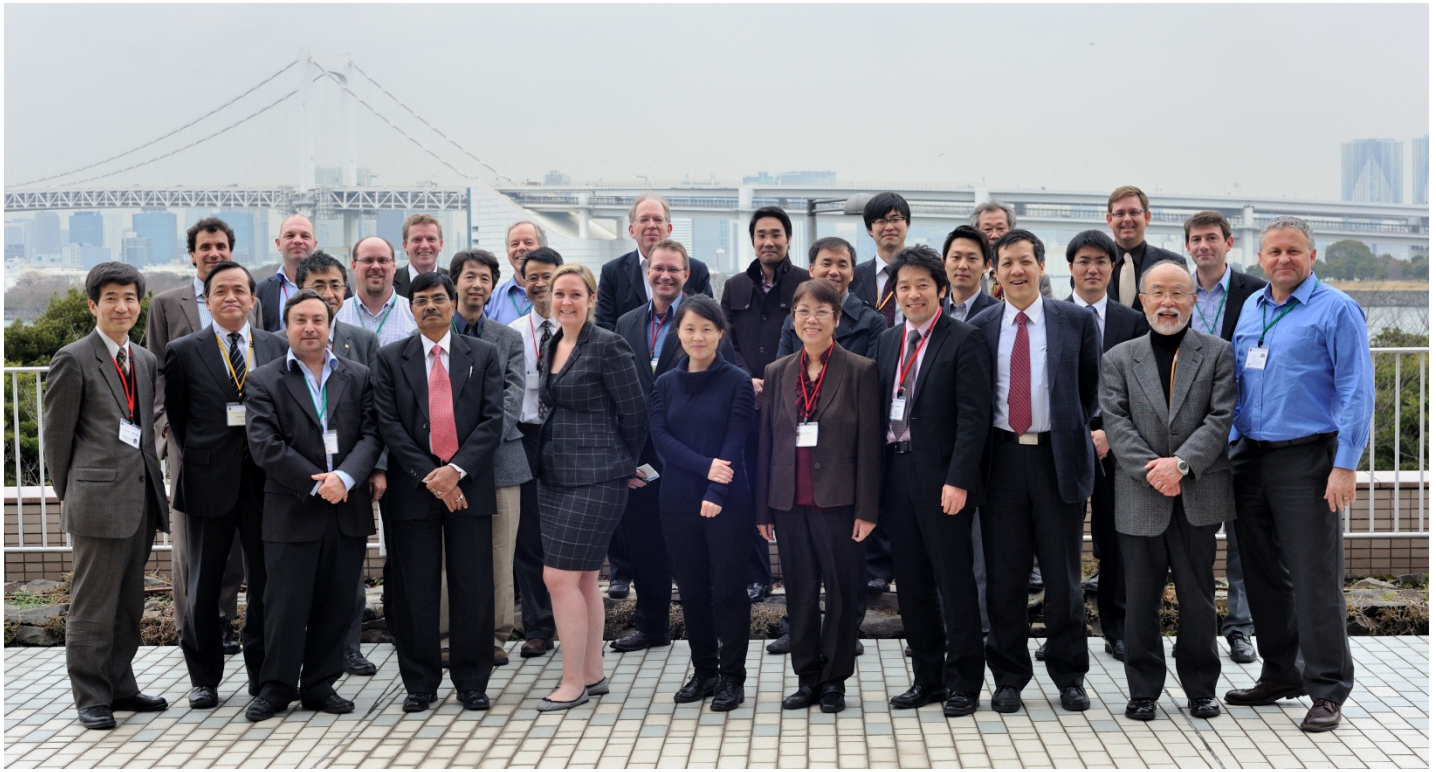
- Definition of key performance characteristics
- Suite of minimum performance levels
- International specification for LED replacement lamp equivalency claims
- Test methods for testing performance characteristics
- Coordinate international accreditation of test labs

Management Committee (MC)

Australia	Melanie Slade (David Boughey)
Denmark	Ture Hammar (Casper Kofod)
France	Bruno Lafitte
Japan	Masanori Sasaki (Norihiko Ozaki)
Netherlands	Daniel Bos
Sweden (*Chair*)	Peter Bennich
UK	Iain Notman
USA	Richard Karney

Participating Experts

United Kingdom	Sweden	China
The Netherlands	Australia	Japan
Denmark	France	USA



SSL Annex: Three main tasks

- Task 1: Develop SSL Quality Assurance
  - Create performance tiers, address equivalency claims
  - Collect data on Life Cycle Assessment, Health issues
- Task 2: SSL Testing
  - Harmonize testing protocols (CIE, IEC, ANSI, etc.)
  - Round Robin #1 to calibrate 4 Nucleus laboratories
  - Round Robin #2 to calibrate participating laboratories
  - Propose proficiency testing procedure for accreditation
- Task 3: Harmonize International Accreditation

Task 1: Quality Assurance

- Minimum Performance requirements for 5 product categories

Non-directional Lamps

Directional Lamps

Downlight Fixtures

LED Linear Fluorescent replacement lamps

Streetlights

Released for comment November 1, 2011

In development

Defining Performance Tiers

- Tier 0: Minimum Acceptable Performance for Off-Grid Applications
- Tier 1: Minimum Acceptable Performance for Grid-Connected Applications
- Tier 2: Performance Required by Established Quality Programs
- Tier 3: Current Highest Commercially Available Performance
- Philosophy: SSL performance is higher than the products they are intended to replace

4E Efficient Electrical End-Use Equipment
International Energy Agency

Solid State Lighting Annex 2010-2014

Participating Countries:
Australia, China, Denmark, France, Japan, The Netherlands, Sweden, The United Kingdom, The United States of America

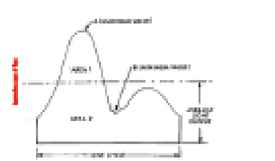
Comments on these Performance Tiers should be submitted in writing to: ssl.annex@gmail.com by February 1, 2012.

Date: November 1, 2011
Status: For Public Release
Author: IEA 4E SSL Annex

Lamp type	Non directional lamp for indoor residential applications

	Minimum light output (lm) and equivalent wattage	Minimum lamp luminous efficacy (lm/W)	Color temperature range (K) and tolerance	Chromaticity tolerance (Duv)	Color Maintenance Δu'v' at 6,000 hrs	Luminous intensity distribution to 135°	CRI	Lamp start time (ms)	Lumen Maintenance (Minimum time to L70)	Minimum Rated Lamp Lifetime (B50)	Flicker (Amplitude Modulation Depth)	Minimum power factor	Harmonic distortion	Dimmer compatibility	Photobiological hazard of Class (UV, Blue light)	Safety marking	Warranty Duration	RoHS Compliant	Recyclability (%)	Rapid Cycling Cycle test
Tier 0	N/A: a large number of these products will be used in off grid applications where light has never been used before. Equivalency in these applications has no meaning.	50 lm/W	N/A		N/A	N/A	N/A	N/A	At 5,000h, Lumen Maintenance >70% of initial	At 5,000h, 50% of population will be operative	At full power (no dimming), percent flicker (calculated as (max-min)/(max+min) luminous flux) ≤ 10%	Current Crest Factor (calculated as (peak/rms) ≤ 3	N/A	N/A	Complies with IEC 62471-2	Must meet regional requirements for marking, if they exist, for non-grid connected devices	Minimum 1 year warranty against catastrophic failure unless regional requirement is higher	Yes	Yes, following electronic component process	Product will survive rapid cycle for every hour of rated life.
Tier 1	Nominal Equivalent Wattage / Minimum Light Output: 20 / 110 25 / 250 30 / 325 35 / 390 40 / 450 60 / 800 75 / 1050 100 / 1600 125 / 2000 150 / 2450 200 / 3450	>60 lm/watt	follow ANSI C78.377, excluding flexible CCT 2700K (2725 ± 145) 3000K (3045 ± 175) 3500K (3465 ± 245) 4000K (3985 ± 275) 5000K (5028 ± 283) 5700K (5665 ± 355) 6500K (6530 ± 510)	 0.000 ± 0.006 0.000 ± 0.006 0.000 ± 0.006 0.001 ± 0.006 0.002 ± 0.006 0.002 ± 0.006 0.003 ± 0.006	<0.007	N/A	≥70	<0.5sec until continuous light output	At 15,000h, Lumen Maintenance >70% of initial	At 15,000h, 50% of population will be operative.	At full power flicker index[] ≤ 0.2	≤5W, no requirement; >5W, PF > 0.50	EAC 7.3A/B FCC CFR47 Section 15 and 18	Lamps may be dimmable or non dimmable. Product packaging shall clearly indicate whether the lamp is dimmable or not dimmable. If a product is declared as dimmable, manufacturer shall also declare the conditions under which a lamp will operate as declared, and shall provide a web address for a website that lists dimmer makes and models with which the lamp is compatible. For each compatible dimmer, the manufacturer must also list the minimum and maximum number of lamps that can be satisfactorily dimmed with a given dimmer and the minimum relative luminous flux level a given dimmer-lamp combination can achieve.	Complies with IEC 62471-2	Must meet regional requirements (ANSI/UL 1993 or CE Mark)	Minimum 1 year warranty against catastrophic failure unless regional requirement is higher	Yes	Yes, following electronic component process	Product will survive rapid cycle for every hour of rated life.
Tier 2	Nominal Equivalent Wattage / Minimum Light Output: 20 / 110 25 / 250 30 / 325 35 / 390 40 / 450 60 / 800 75 / 1050 100 / 1600 125 / 2000 150 / 2450 200 / 3450	>65 lm/watt	follow ANSI C78.377, excluding flexible CCT 2700K (2725 ± 145) 3000K (3045 ± 175) 3500K (3465 ± 245) 4000K (3985 ± 275) 5000K (5028 ± 283) 5700K (5665 ± 355) 6500K (6530 ± 510)	 0.000 ± 0.006 0.000 ± 0.006 0.000 ± 0.006 0.001 ± 0.006 0.002 ± 0.006 0.002 ± 0.006 0.003 ± 0.006	<0.007	Products shall have an even distribution of luminous intensity within the 0° to 135° zone (symmetrical about the vertical axis). Luminous intensity at any angle within this zone shall not differ from the mean luminous intensity for the entire 0° to 135° zone by more than 20%. At least 5% of total flux must be emitted in the 135°-180° zone. Distribution shall be vertically symmetrical in three vertical planes, 0°, 45°, 90°.	≥80, R9 > 0	<0.5sec until continuous light output	At 25,000h, Lumen Maintenance >70% of initial	At 25,000h, 50% of population will be operative.	At full power flicker index[] ≤ 0.2	≤5W, no requirement; >5W, PF > 0.50	EAC 7.3A/B FCC CFR47 Section 15 and 18	Lamps may be dimmable or non dimmable. Product packaging shall clearly indicate whether the lamp is dimmable or not dimmable. If a product is declared as dimmable, manufacturer shall also declare the conditions under which a lamp will operate as declared, and shall provide a web address for a website that lists dimmer makes and models with which the lamp is compatible. For each compatible dimmer, the manufacturer must also list the minimum and maximum number of lamps that can be satisfactorily dimmed with a given dimmer and the minimum relative luminous flux level a given dimmer-lamp combination can achieve.	Complies with IEC 62471-2	Must meet regional requirements (ANSI/UL 1993 or CE Mark)	Minimum 1 year warranty against catastrophic failure unless regional requirement is higher	Yes	Yes, following electronic component process	Product will survive rapid cycle for every hour of rated life.
Tier 3	Nominal Equivalent Wattage / Minimum Light Output: 20 / 110 25 / 250 30 / 325 35 / 390 40 / 450 60 / 800 75 / 1050 100 / 1600 125 / 2000 150 / 2450 200 / 3450	>80 lm/W	follow ANSI C78.377: 2011 Table 5A, for 4-step quadrangle excluding flexible CCT 2700K (2725 ± 93) 3000K (3045 ± 98) 3500K (3465 ± 120) 4000K (3985 ± 158) 5000K (5028 ± 200) 5700K (5665 ± 225) 6500K (6530 ± 340)	 -0.0006 ± 0.0030 -0.0006 ± 0.0030 -0.0002 ± 0.0030 0.0008 ± 0.0030 0.0016 ± 0.0030 0.0024 ± 0.0030 0.0031 ± 0.0030	<0.004	Products shall have an even distribution of luminous intensity within the 0° to 135° zone (symmetrical about the vertical axis). Luminous intensity at any angle within this zone shall not differ from the mean luminous intensity for the entire 0° to 135° zone by more than 20%. At least 5% of total flux must be emitted in the 135°-180° zone. Distribution shall be vertically symmetrical in three vertical planes, 0°, 45°, 90°.	≥80, R9 > 0	<0.5sec until continuous light output	At 25,000h, Lumen Maintenance >70% of initial	At 25,000h, 50% of population will be operative.	At full power flicker index[] ≤ 0.2	≤5W, no requirement; >5W, PF > 0.50	EAC 7.3A/B FCC CFR47 Section 15 and 18	Lamps may be dimmable or non dimmable. Product packaging shall clearly indicate whether the lamp is dimmable or not dimmable. If a product is declared as dimmable, manufacturer shall also declare the conditions under which a lamp will operate as declared, and shall provide a web address for a website that lists dimmer makes and models with which the lamp is compatible. For each compatible dimmer, the manufacturer must also list the minimum and maximum number of lamps that can be satisfactorily dimmed with a given dimmer and the minimum relative luminous flux level a given dimmer-lamp combination can achieve.	Complies with IEC 62471-2	Must meet regional requirements (ANSI/UL 1993 or CE Mark)	Minimum 2 year warranty against catastrophic failure unless regional requirement is higher	Yes	Yes, with recovery of materials (phosphors, base materials)	Product will survive rapid cycle for every hour of rated life.

[] Flicker index defined by Area 1/(Area 1+Area2), replaced by new metric under development by IEEE PAR1789 which accounts for frequency, when available



Life Cycle Assessment

- Draft report is complete but results of new DOE report (soon to be released) are being reviewed for possible incorporation into IEA report
- One of the key findings: greatest impact of lamp technology is related to luminous efficacy of system (energy, CO2)

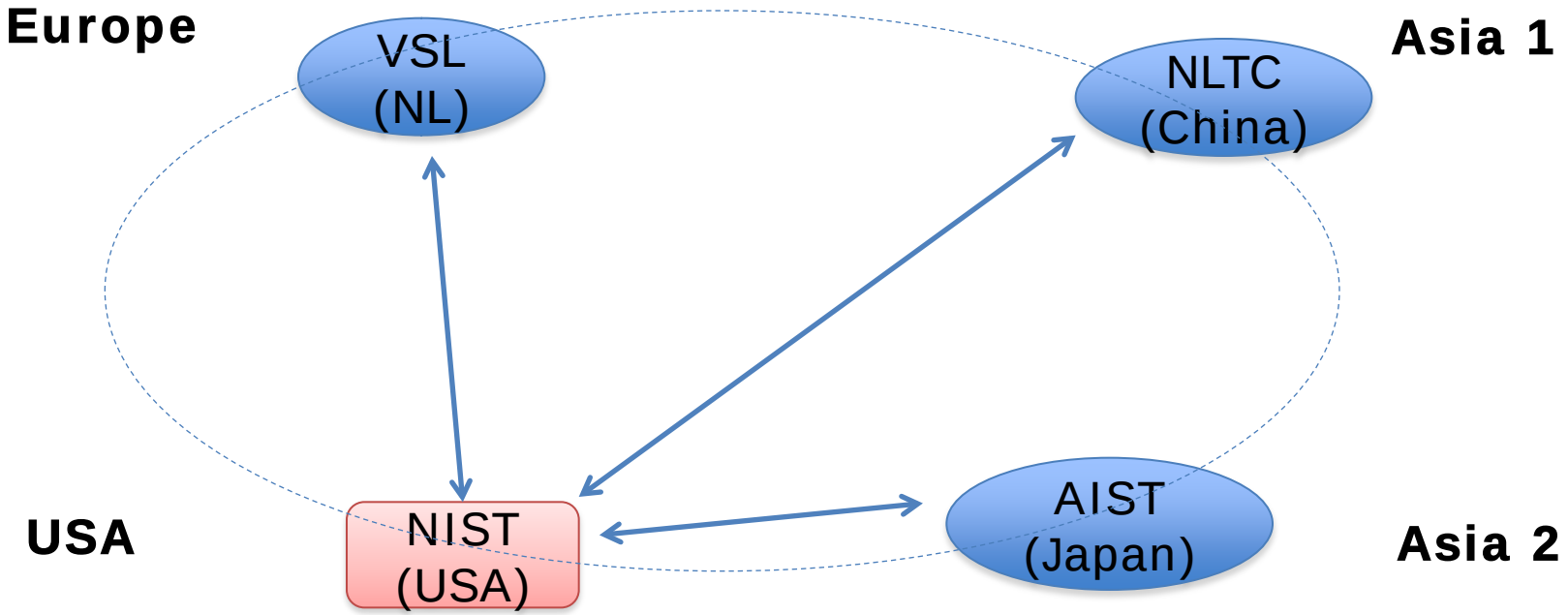
Task 2: SSL Testing

- How do we improve fundamental laboratory competence in testing SSL?
- How do we improve consistency in test results among laboratories?
- Currently, there is no program of International Round Robins for SSL and only NIST offers SSL Proficiency Testing.

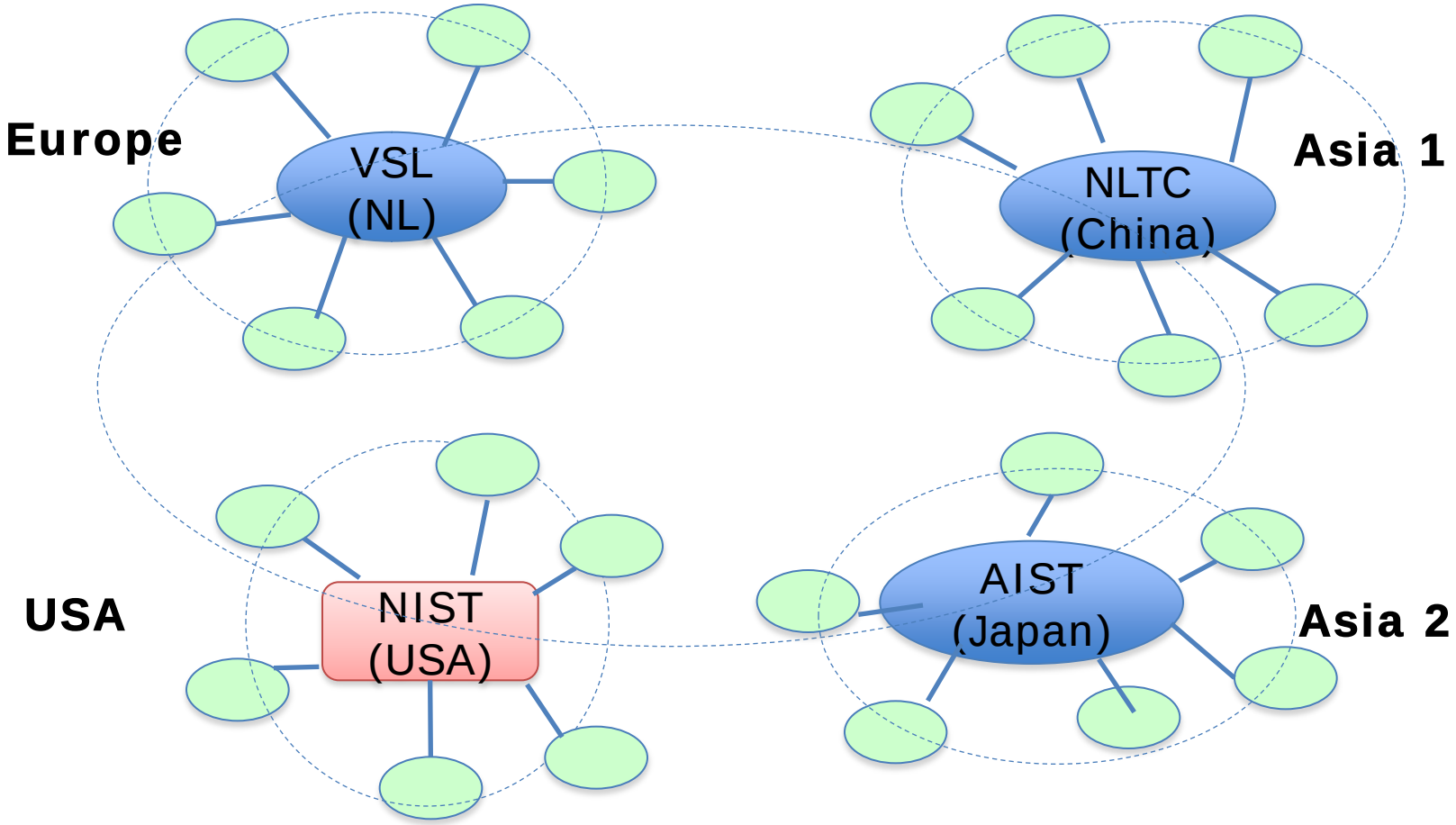
Task 2: SSL Testing

- Harmonize testing protocols (CIE, IEC, ANSI, etc.), suggest improvements
- Round Robin#1 now complete; cross-calibrated four nucleus laboratories
- Round Robin#2 will verify proficiency of participating laboratories
- Design RR2 in accordance with ISO 17043 (round robin/proficiency testing procedure) so accreditation bodies can use it when evaluating a laboratory for accreditation

Task 2: Round Robin 1: Calibrating Nucleus labs

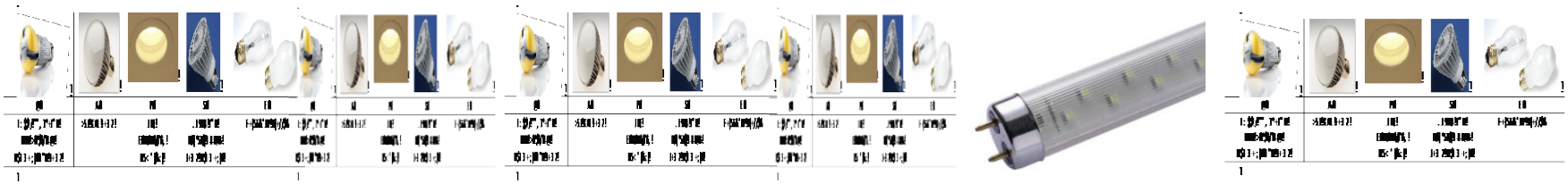


Task 2: Round Robin 2: Calibrating SSL labs



Task 2: Round Robin #1

- 6 lamps test labs’ ability to competently test SSL
  - Philips lamp: measure remote phosphor products
  - LSI-G25 lamp: measure current waveform with large THD
  - CREE LR6: measure active feedback
  - Sylvania PAR20 : measure directional lamp
  - LED DC Linear replacement lamp: Measure high CCT
  - Incandescent standard lamp compares fundamental laboratory photometric measurement quality



Task 2: RR2 Suggested Approach

1. Required to test:
    1. Light output (lm)
    2. Luminous Efficacy (lm/watt)
    3. CCT
    4. Chromaticity and Duv
    5. CRI
    6. Power (W) and Power Factor

2. Optional to test depending on Lab's equipment
    1. Center Beam Luminous Intensity
    2. Color Spatial Uniformity
    3. Luminous Intensity Distribution
    4. Lag Start Time
    5. Harmonic Distortion

Task 2: Round Robin 2 Test Method

- The IEA SSL method of measurement for use in RR2 will encompass all common requirements for fundamental properties that exist in regional methods of measurement in the member countries and all known international standards being developed

Task 2: Round Robin 2 Timeline

- Announcement of RR2 in July (tentative)
- Applications accepted for two months
- Laboratories selected from applicants
- Start RR2 in November, run for 6 months

Task 3: Standards for Testing Reliability

- Approach global accreditation organizations to determine if they will recognize Round Robin2 as valid Proficiency Testing.
- Examine current structure of accreditation, certification and identify areas of concern.

Task 3: Proficiency Testing

- If a laboratory successfully passes RR2,
  - It can claim that it has the ability to conduct the tests under especially tight conditions.
  - It can show the results of the comparative study on a common artifact between RR2 method and its normal procedure to its AB to be accredited.

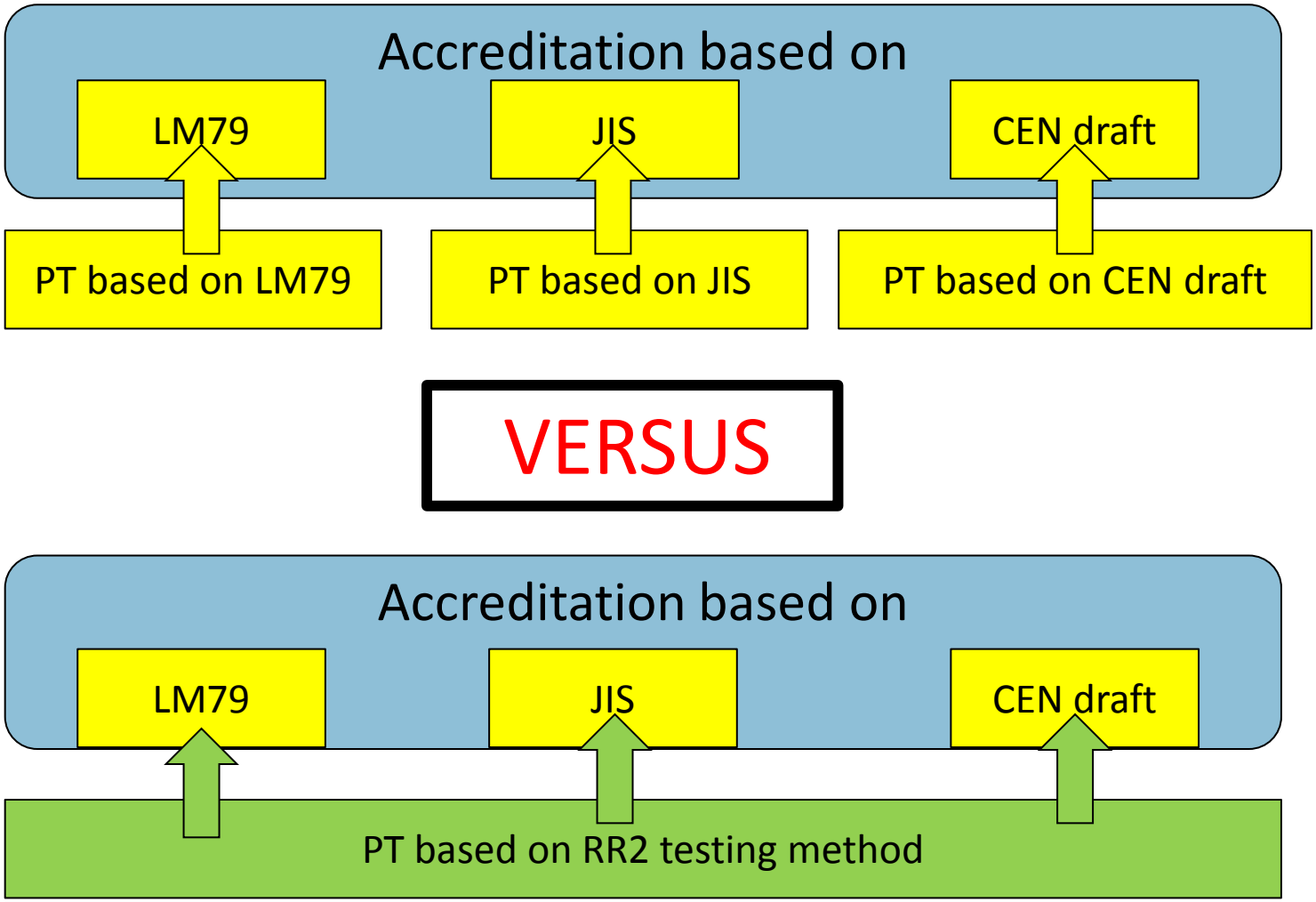
Task 3: Proficiency Testing

- Successful completion of RR2 should be considered evidence of Proficiency Testing (PT) for ANY of SSL method of measurement currently being used or currently in draft.
- This includes IES LM-79, CIE or CEN method of measurement (when published), JIS method of measurement, IEC PAS Method of Measurements in annexes
- RR2 is now designed to use the most stringent parts of the existing test methods

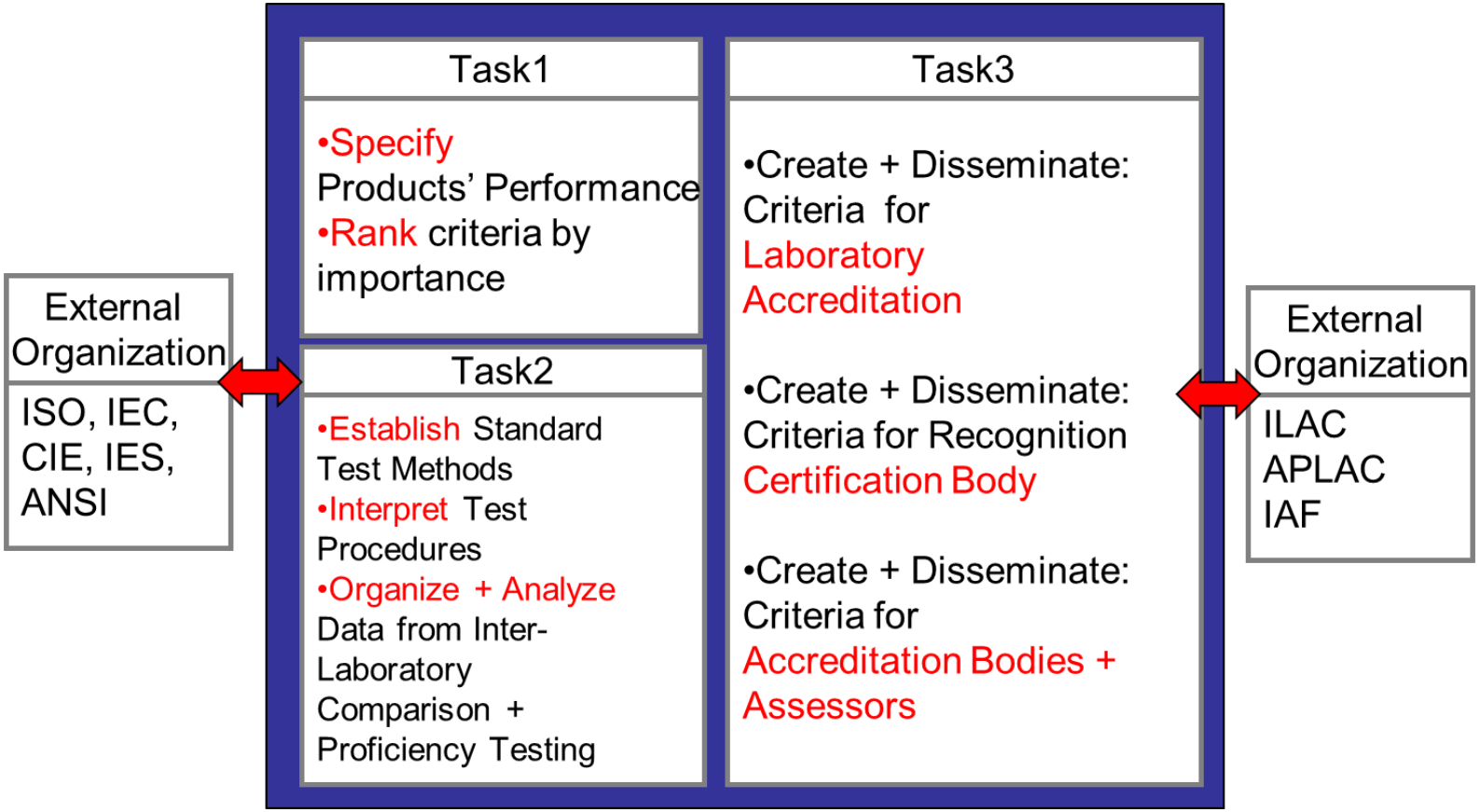
Task 3: Proficiency Testing

- If RR2 is recognized as PT, ABs will be able to accredit laboratories per ISO 17025 for SSL testing.
- We will work with ABs and other stakeholders to recommend that successful RR2 results be accepted as valid PTs for all of these test methods standards.
- Actual acceptance of this by an AB will be a decision by each AB.

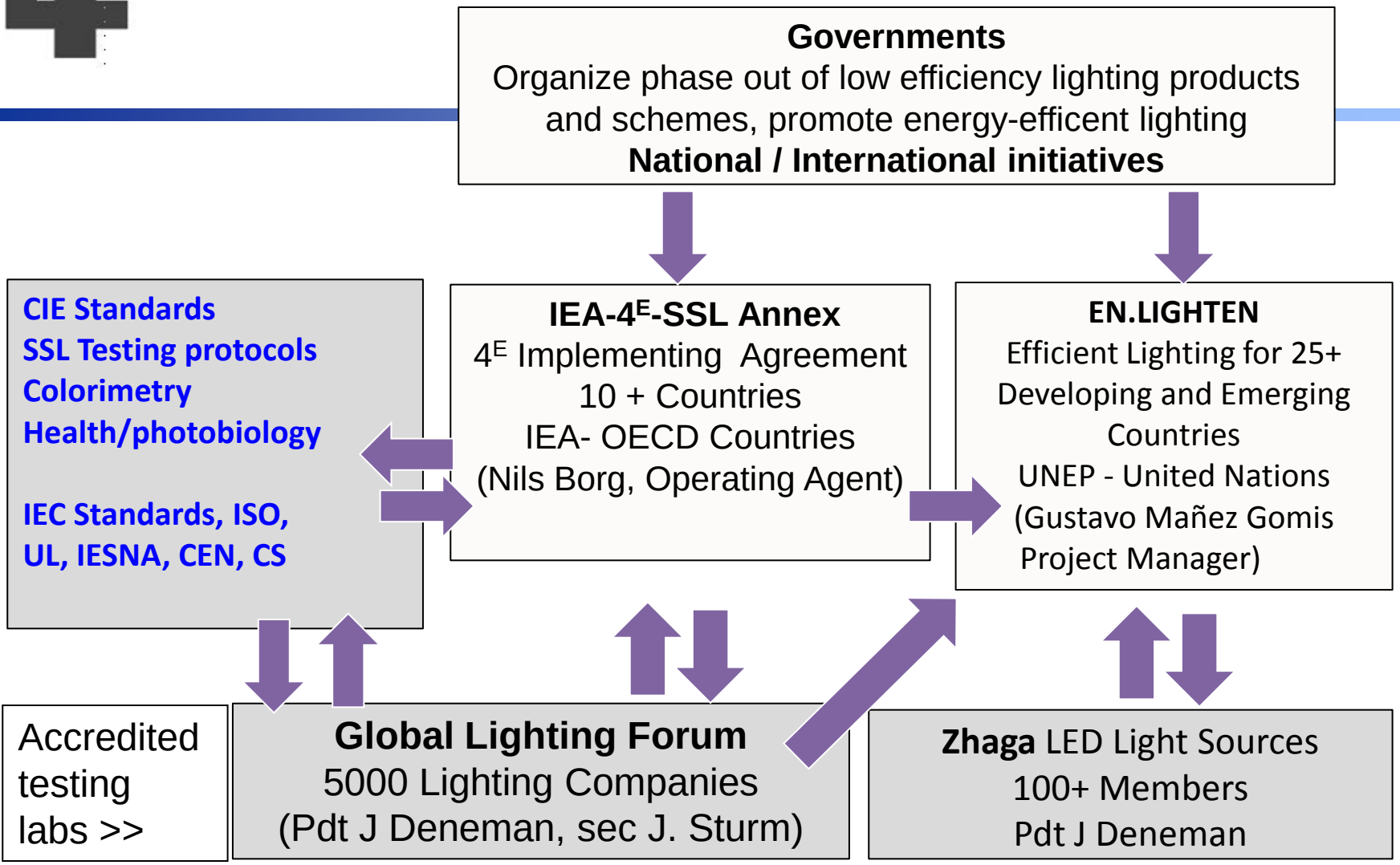
Task 3: One-stop SSL PT program



Links with Accreditation organizations + Laboratories



Linking Initiatives



Thank you!

- http://ssl.iea-4e.org/

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